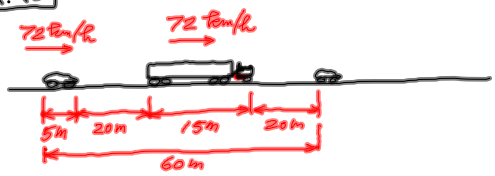
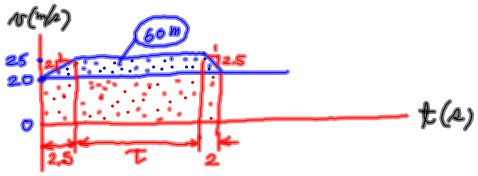
11.48



$72\,km/h = 20\,m/s$

$a = \begin{cases} 2\,m/s^2 \\ -2.5\,m/s^2 \end{cases}$

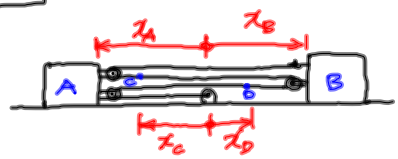
$90\,km/h = 25\,m/s$



$\frac{1}{2}[(45+\tau)+\tau](5) = 60 \qquad \therefore \tau = \square$

$t_A = 2.5 + \tau + 2 = \square \qquad \boxed{t_A = \square\, s}$

11.32 Dependent rectilinear motion



$\vec{v}_A = 1.2\,m/s \leftarrow$

$\vec{v}_B = ? \quad \vec{v}_C = ?$

$\vec{v}_D = ? \quad \vec{v}_{A/B} = ?$

$v_A = +1.2$

$4x_A + 3x_B = k \qquad 4v_A + 3v_B = 0 \qquad 4(1.2) + 3v_B = 0$

$v_B = -1.6 \qquad \boxed{\vec{v}_B = 1.6\,m/s \leftarrow}$

$x_B + x_A + (x_A - x_C) = k_1 \qquad 2x_A + x_B - x_C = k_1$

$2v_A + v_B - v_C = 0 \qquad 2(1.2) + (-1.6) - v_C = 0$

$v_C = 2.4 - 1.6 = 0.8 \qquad \boxed{\vec{v}_C = 0.8\,m/s \leftarrow}$

$2x_A + 2x_B + (x_B - x_D) = k_2 \qquad 2x_A + 3x_B - x_D = k_2$

$2v_A + 3v_B - v_D = 0 \qquad 2(1.2) + 3(-1.6) - v_D = 0$

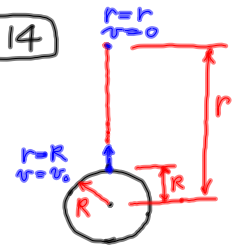
$v_D = 2.4 - 4.8 = -2.4 \qquad \boxed{\vec{v}_D = 2.4\,m/s \leftarrow}$

$\vec{v}_{A/B} = \vec{v}_A - \vec{v}_B = (1.2\,m/s \leftarrow) - (1.6\,m/s \leftarrow)$

$= [-1.2\vec{i} - (-1.6\vec{i})]\,m/s = (-1.2 + 1.6)\vec{i}\,m/s$

$= 0.4\vec{i}\,m/s \qquad \boxed{\vec{v}_{A/B} = 0.4\,m/s \rightarrow}$

11.14



$a = -gR^2/r^2 = -gR^2 r^{-2}$

$a = \frac{dv}{dt} = \frac{dv}{dr}\frac{dr}{dt} = \frac{dv}{dr}v$

$a\,dr = v\,dv$

$\int_R^r -gR^2 r^{-2}\,dr = \int_{v_0}^0 v\,dv$

$gR^2 r^{-1}\Big|_R^r = \frac{1}{2}v^2\Big|_{v_0}^0$

$gR^2\left(\frac{1}{r} - \frac{1}{R}\right) = \frac{1}{2}(0 - v_0^2) = -\frac{1}{2}v_0^2$

$\therefore r = \square = R + h \qquad \boxed{h = \square\, m}$

$(g = 9.81\,m/s^2 \qquad R = 6.37 \times 10^6\,m)$
